DOCUMENT RESUME

ED 219 266 SE 038 772

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TITLE Chemical Literature Exercises and Resources (CLEAR).
PUB DATE 82
NOTE 44p.

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Abstracts; *Chemistry; *College Science; Higher Education; *Information Retrieval; Information Sources; Instructional Materials; *Library Instruction; Primary Sources; Resource Materials; Science Education; *Search Strategies
IDENTIFIERS *Chemical Abstracts

ABSTRACT

These materials were developed to make the structure and use of the chemical literature clear to chemistry students and to help them become independent and intelligent users of the library. The design of Chemical Literature Exercises and Resources (CLEAR) includes a users' note and five main parts: introduction to chemical literature, chemical bibliography, and three exercises. The users' note outlines the purposes, design, subject matter, and use of CLEAR. The introduction to chemical literature provides a rationale for library research, some remarks on literature guides, and general information on both the structure and use of chemical literature. The bibliography gives specific references to the tertiary chemical literature grouped by type (encyclopedias, texts, treatises, and dictionaries among others). In Exercise 1 students pick 20 specific chemical questions to answer using tertiary sources. In Exercise 2 students build a bibliography of a chemical topic starting with tertiary sources and progressing to secondary materials (review journals, annual reviews, and monographs). Exercise 3 gives students practice in using "Chemical Abstracts" and the primary literature sources, journal articles, personal journals/notebooks, news releases, conference abstracts/proceedings, reports, dissertations, theses, and patents. (Author/JN)

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CHEMICAL LITERATURE EXERCISES AND RESOURCES (CLEAR)

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A NOTE TO CLEAR USERS

The purpose of these materials is to make the structure and use of the chemical literature clear to chemistry students. Over the years we have observed far too often the helplessness and ignorance of students when they are confronted with the need to find chemical information in the library. CLEAR was designed to help students become independent and intelligent users of the library.

The design of CLEAR includes a users' note and five main parts: an introduction to the chemical literature, a chemical bibliography, and three exercises. The users' note outlines the purposes, design, subject matter, and use of CLEAR. The introduction to the chemical literature provides a rationale for library research, some remarks on literature guides, and general information on both the structure and the use of chemical literature. The bibliography gives specific references to the tertiary chemical literature grouped by type (i.e., encyclopediae, texts, treatises, dictionaries, etc.). In Exercise 1 students pick twenty specific chemical questions to answer using tertiary sources. In Exercise 2 students build a bibliography on a chemical topic starting with tertiary sources and progressing to secondary materials. Finally, Exercise 3 gives students some practice in using Chemical Abstracts and the primary literature.

The subject matter chosen for Exercises 1-3 reflect the interests of the authors and the context in which the Exercises were developed. You may wish to modify the subject matter, but the format of the Exercises should be suitable for any chemistry course.

Our use of the CLEAR materials was in the first week of a 3 credit physical chemistry lab course in the Spring of 1982. The introduction and bibliography were presented in a lab lecture (1½ hr.). Exercises 1 and 3 were assigned as homework. Exercise 2 was done as a part of a walking tour of our library (3 hr.).

Student evaluations of the CLEAR materials were very positive. In a research project assigned later in the physical chemistry lab course, students seemed to make independent and intelligent use of the library. We encourage you to improve CLEAR and hope you derive as much satisfaction from its use as we have.

I. INTRODUCTION TO THE CHEMICAL LITERATURE

On the importance of past knowledge to future progress...*

> Knowledge is of two kinds. We know a subject ourselves, or we know where we can find information upon it. Johnson

> Very little advance in culture could be made, even by the greatest man of genius, if he were dependent for what knowledge he might acquire upon his own personal observations. Libby

> Those who cannot remember the past are condemned to repeat it. Santayana

On the use and abuse of a library...*

> By a fiction as remarkable as any to be found in law, what has once been published (no matter what the language) is usually spoken of as known, and it is often forgotten that the rediscovery in the library may be a more difficult and uncertain process than the first discovery in the laboratory. Lord Rayleigh

> Anyone who wants to use a library effectively must already have some knowledge of the same nature as that which he hopes to find there. If not, he does not know where or how to look; nor can he grasp fully what he finds, even if he happens to hit upon the right book. Sir William L. Bragg

> Of making many books, there is no end; and much study is a weariness of the flesh. Ecclesiastes 12:12

RATIONALE

Why should practicing scientists concern themselves with the scientific literature at all? If we need information and do not know it ourselves, why not ask a scientist who does? Or design a clever experiment? Or postulate and test an elegant theory?

All these ways of obtaining information - conferences with colleagues, performing experiments, and theorizing - are necessary, but they are not by themselves sufficient. Colleagues are not always available or

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*Quotes selected from those appearing in M. G. Mellon, Chemical Publications, 4th ed., McGraw-Hill: New York, 1965.

informed, experiments can be costly and time consuming, and sometimes (often?) our imagination and reason fail to create adequate theory. In these instances and many others, the library is as indispensable to the working scientist as the chromosome to the working cell.

The professional scientist must, then, be competent in library as well as laboratory research. Competence in the library is no more easily achieved than competence in the lab (see the quotes above by Rayleigh and Bragg). Both skills must be learned and practiced.

CLEAR MATERIALS

These CLEAR* materials are designed to help students learn and practice library skills. This is Part I, An Introduction to the Chemical Literature, in which the structure and use of the chemical literature will be explained. Part II, A Chemical Bibliography, gives specific references to resources which will be of use to you as you plan and carry out a search for chemical information. Parts III, IV, and V are Exercises in which you practice what was learned in Parts I and II.

GUIDES TO THE CHEMICAL LITERATURE

Several guides to the chemical literature are listed in Part II, A Chemical Bibliography. These guides are entire books on the chemical literature by specialists in the subject. The guides differ somewhat in their coverage and bias (some are more academic and others more industrial), but each provides a wealth of detailed information.

The CLEAR materials should serve as a brief but effective introduction to the chemical literature for undergraduates. Graduate students and professional chemists may also find CLEAR useful, but will undoubtedly wish

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*CLEAR is an acronym for Chemical Literature Exercises and Resources.

to consult one or more of the guides for a more comprehensive and sophisticated treatment.

THE STRUCTURE OF THE CHEMICAL LITERATURE

The literature of any field of knowledge can be broken down into primary, secondary, and tertiary sources. In order to use and evaluate the literature of a particular discipline, it is important to understand what primary, secondary, and tertiary sources are, how they differ, and how they relate to one another.

Reports of original research are the backbone of scientific literature and constitute primary sources. These reports may be produced in many forms. You are probably most familiar with them as journal articles (note that not all journal articles are primary). Original research may also take the form of a personal journal or notebook, a dissertation or thesis, a conference proceeding, a government report, or a patent. Journal articles tend to be more formal and authoritative, whereas notebooks are much less so. The record of any one original research may progress from notebook to conference paper to journal article status.

Secondary sources are one step removed from this and can generally be regarded as summaries or surveys of primary materials. These summaries may appear as journal articles, monographs (books), or review serials (such as the Annual Review of Physical Chemistry[1]).

Tertiary materials are even further removed from primary sources in that they are summaries of secondary or listings of secondary and primary source information. Some tertiary sources present summaries of fairly general information (encyclopediae, texts, treatises). Others are intended for a specific audience or purpose and present only specific

information, data or definitions. Still others are lists used to locate primary, secondary or tertiary literature. The relationships of these types of literature are shown in the chart on the following page.

SEARCHING THE CHEMICAL LITERATURE

It is useful to distinguish two types of searches from one another: 1) searches for specific chemical information, and (2) searches for general information on a chemical topic. When specific information is sought (e.g., a definition, a composition, a synthesis or analysis, numerical data), it can often be found in a reference in the tertiary literature (e.g., a dictionary, formulary, methodology, table or handbook). In Exercise 1 you choose twenty specific chemical questions to answer using tertiary sources listed in Part II, A Chemical Bibliography.

STRUCTURE OF THE CHEMICAL LITERATURE

PRIMARY	SECONDARY	TERTIARY
Diaries	Review journals	General
Personal journals or notebooks	Annual reviews	Encyclopediae and atlases Textbooks Treatises
News releases	Monographs	Specific
Conference abstracts or proceedings		Dictionaries Nomenclature Formularies Biographies Methodologies Tables and handbooks
Reports		
Dissertations or theses		Lists
Patents		Literature guides Card catalogs Indexes and abstracts Directories Bibliographies
Journal articles		
FIRST RECORDING	SUMMARY OF FIRST RECORDING	SUMMARY OF SUMMARY
		LISTING OF SUMMARY
		LISTING OF FIRST RECORDING

Searches for general information on a chemical topic usually start in the tertiary literature with dictionaries and encyclopediae, work into the secondary literature (often via the card catalog), and finally enter the primary literature (often via abstracts or indexes such as Chemical Abstracts or Science Citation Index). Exercise 2 gives you some practice with this type of search. When you have finished Exercise 2, you should be able to build a bibliography on any chemical topic with very little help from others.

Exercise 3 is on Chemical Abstracts - one of the most important and frequently used resources in the search for chemical information. Chemical Abstracts is usually the most efficient route to the specialized and specific information to be found in the primary literature. This information may be sought to complete research on a chemical topic or to obtain answers to a specific (but rather specialized) question. Exercise 3 helps you to become acquainted with both applications of Chemical Abstracts.

II. A CHEMICAL BIBLIOGRAPHY

The bibliography of chemical resources which follows is not in any sense an official bibliography. It has, however, been culled from the standard guides to the chemical literature (referenced in the bibliography below) and is believed to be a useful and fairly complete representation of the most important chemical references in the tertiary literature.

The organization of the bibliography is the same as that of the chart in Part I on the structure of the chemical literature. All the references are to the tertiary literature - the more general information sources first, then the more specific, and finally the lists of sources of information.

GENERAL INFORMATION

ENCYCLOPEDIAE

McGraw-Hill Encyclopedia of Science and Technology. 5th ed. New York: McGraw-Hill, 1981.

Van Nostrand's Scientific Encyclopedia. 5th ed. New York: Van Nostrand Reinhold, 1976.

Kingzett, Charles T. Kingzett's Chemical Encylopedia: A Digest of Chemistry and Its Industrial Applications. London: Bailliere, Tindall & Cassell, 1966.

The Encyclopedia of Chemistry. 3rd ed. New York: Van Nostrand Reinhold, 1973.

The Encyclopedia of the Chemical Elements. New York: Reinhold Book Corp., 1968.

The Merck Index: An Encyclopedia of Chemicals and Drugs. 9th ed. Rahway, NJ: Merck, 1976.

Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed. New York: Wiley, 1979.

Leung, Albert Y. Encyclopedia of Common Natural Ingredients Used in Food, Drugs, Cosmetics, and Medicine. New York: Wiley, 1980.

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Fairbridge, R. (ed.) Encyclopedia of Geochemistry and Environmental Sciences. New York: Academic Press, 1972. Encyclopedia of Earth Sciences Series, Volume IVA.

Deer, W. A. Rock Forming Minerals. New York: Halstead Press, 1962- . 5 volumes.

Jacobson, Carl A. Encyclopedia of Chemical Reactions. New York: Reinhold, 1959.

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Physical Chemistry Lecture

Atkins, Peter W. Physical Chemistry. San Francisco, CA: W. H. Freeman, 1978.

Daniels, Farrington & R. Alberty. Physical Chemistry. 5th ed. New York: Wiley, 1979.

Barrow, Gordon M. Physical Chemistry. 4th ed. New York: McGraw-Hill, 1979.

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Moore, Walter J. Physical Chemistry. 4th ed. Englewood Cliffs, NJ: Prentice Hall, 1972.

Levine, Ira N. Physical Chemistry. New York: McGraw-Hill, 1978.

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Salzberg, Hugh W. Physical Chemistry Laboratory: Principles and Experiments. New York: Macmillan, 1978.

White, John M. Physical Chemistry Laboratory Experiments. Englewood Cliffs, NJ: Prentice Hall, 1974.

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General Chemistry

Brown, Theodore L. & H. Eugene LeMay, Jr. Chemistry: The Central Science. 2nd ed. Englewood Cliffs, NJ: Prentice Hall, 1981.

Dickerson, Richard E., Harry B. Gray, & Gilbert P. Haight, Jr. Chemical Principles. 3rd ed. Menlo Park, CA: Benjamin/Cummings Pub. Co., 1979.

Mahan, Bruce H. University Chemistry. 3rd ed. Reading, MA: Addison-Wesley, 1975.

Waser, Jurg, K. N. Trueblood, & C. M. Knobler. Chem One. New York: McGraw-Hill, 1976.

Holum, John R. Fundamentals of General, Organic, and Biological Chemistry. New York: Wiley, 1978.

Hein, Morris. Foundations of College Chemistry. 5th ed. Monterey, CA: Brooks/Cole Pub. Co., 1982.

Hill, John W. Chemistry for Changing Times. 3rd ed. Minneapolis, MN: Burgess, 1980.

Miller, G. Tyler. Chemistry: Principles and Applications. Belmont, CA: Wadsworth, 1976.

Manahan, Stanley. General Applied Chemistry. 2nd ed. Boston, MA: Willard Grant Press, 1982.

Analytical Chemistry

Skoog, Douglas & D. M. West. Fundamentals of Analytical Chemistry. 4th ed. Philadelphia, PA: Saunders College, 1982.

Skoog, Douglas & D. M. West. Principles of Instrumental Analysis. 2nd ed. Philadelphia, PA: Saunders College, 1980.

Willard, Hobart H., L. L. Merritt, Jr. & J. A. Dean. Instrumental Methods of Analysis. 5th ed. New York: Van Nostrand, 1981.

Inorganic Chemistry

Cotton, F. Albert & G. Wilkinson. Advanced Inorganic Chemistry: A Comprehensive Text. 4th ed. New York: Wiley, 1980.

Purcell, Keith F. & J. C. Kotz. An Introduction to Inorganic Chemistry. Philadelphia, PA: Saunders College, 1980.

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Biochemistry

Stryer, Lubert. Biochemistry. 2nd ed. San Francisco, CA: W. H. Freeman, 1981.

Lehninger, Albert L. Biochemistry: The Molecular Basis of Cell Structure and Function. 2nd ed. New York: Worth Publishers, 1977.

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Mason, Brian. Principles of Geochemistry. 3rd ed. New York: Wiley, 1966.

Environmental Chemistry

Turk, Amos. Environmental Science. 2nd ed. Philadelphia, PA: Saunders, 1978.

Miller, G. Tyler. Living in the Environment. 3rd ed. Belmont, CA: Wadsworth, 1981.

Nebel, Bernard J. Environmental Science, The Way The World Works. Englewood Cliffs, NJ: Prentice Hall, 1981.

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Ihde, Aaron J. The Development of Modern Chemistry. New York: Harper & Row, 1964.

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Asimov, Isaac. A Short History of Chemistry. Westport, CT: Greenwood Press, 1979.

Weeks, Mary E. & Henry M. Leicester. Discovery of the Elements. 7th ed. Easton, PA: Journal of Chemical Education, 1968.

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Eyring, Henry, D. Henderson, & W. Jost (Eds.). Physical Chemistry, An Advanced Treatise. New York: Academic Press, 1967- . 11 volumes.

International Encyclopedia of Physical Chemistry and Chemical Physics. New York: Macmillan, 1965- .

International Encyclopedia of Physical Chemistry and Chemical Physics. Topic 2: Classical and Quantum Mechanics. New York: Pergamon Press, 1972- .

Partington, James. An Advanced Treatise on Physical Chemistry. New York: Longmans, Green and Co., 1949-54. 5 volumes.

Methods of Experimental Physics. New York: Academic Press, 1959- .

Reilly, Joseph & William N. Rae. Physico-Chemical Methods. New York: Van Nostrand, 1948-1953. 3 volumes.

Techniques of Chemistry. New York: Wiley Interscience, 1970- .

History

Partington, James R. A History of Chemistry. London: Macmillan, 1961-70. 4 volumes.

Analytical Chemistry

Kolthoff, Izaak M. & P. J. Elving (Eds). Treatise on Analytical Chemistry. New York: Interscience Encyclopedia, 1959- .

Snell, Foster D. & Cornelia T. Snell. Colorimetric Methods of Analysis, Including Some Turbidimetric and Nephelometric Methods. 3rd ed. New York: Van Nostrand, 1948- . 4 volumes.

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Florkin, Marcel. Comparative Biochemistry: A Comprehensive Treatise. New York: Academic Press, 1960-64. 7 volumes.

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Methodologies, Tables and Handbooks

Handbook of Chemistry and Physics: A Ready Reference Book of Chemical and Physical Data. 61st ed. Boca Raton, FL: Chemical Rubber Co., 1980.

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Inorganic Syntheses. New York: Wiley, 1939- .

Organic Syntheses. New York: Wiley, 1932- .

Biochemical Preparations. New York: Wiley, 1949-1971. 13 volumes.

Style Guides

Fieser, Louis F. Style Guide for Chemists. New York: Reinhold, 1960.

American Chemical Society. Handbook for Authors of Papers in American Chemical Society Publications. Washington: American Chemical Society, 1978.

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Guides to the Literature

Mellon, Melvin G. Chemical Publications, Their Nature and Use. 4th ed. New York: McGraw-Hill, 1965.

Antony, Arthur. Guide to Basic Information Sources in Chemistry. New York: J. Norton Publishers, 1979.

Maizell, Robert E. How to Find Chemical Information: A Guide for Practicing Chemists, Teachers, and Students. New York: Wiley, 1979.

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Bibliographies

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Chemisches Zentralblatt. 1830-1969.

British Abstracts. 1926-1953.

Dissertation Abstracts International. 1938- .

Applied Science and Technology Index. 1958- .

Science Citation Index. 1961- .

Current Contents/Physical and Chemical Sciences. 1961- .

Chemical Titles. 1960- .

Index of Review in Organic Chemistry. 1959- .

Directories

American Chemical Society. Committee on Professional Training. Directory of Graduate Research. 1953- .

American Chemical Society. College Chemistry Faculties. 5th ed. Washington, DC: American Chemical Society, 1980.

American Men and Women of Science. 14th ed. New York: Bowker, 1979.

Books in Print. New York: Bowker, 1981-82.

Paperbound Books in Print. New York: Bowker, 1981.

Thomas Register of American Manufacturers and Thomas Register Catalog File. 72nd ed. New York: Thomas Pub. Co., 1982. 17 volumes.

III. EXERCISE 1.

SEARCHING FOR SPECIFIC CHEMICAL INFORMATION

Use dictionaries, encyclopediae, texts, treatises, formularies, biographies, directories, tabular compilations, manuals, abstracts, indexes, and the card catalog to locate a useful reference for two subjects in each category A-K. Give one specific reference (chapters or page numbers) for each subject. Do not give the information. Do not spend excessive time on any one subject.

A. Definitions

1. Shellac
2. Natural gas
3. Pycnometer
4. Nicol prism
5. Dialysis
6. Curie temperature
7. Kerr effect
8. Nomograph
9. Disproportionation
10. Electromotive series
11. Virial equation
12. Plate tectonics theory

B. Composition of

1. Hydrazine
2. Glauber's salt
3. Ruby
4. Feldspars
5. Skunk oil
6. Stainless steel
7. Fehling solution
8. Portland cement
9. Formulae of embalming fluids
10. Flux for nichrome welding
11. Recipe for screwworm control

C. Existence, Occurrence, Source, Recovery

1. Existence of chlorine substitution products of propane
2. Crustal abundance of Ti
3. Occurrence of arsenic
4. Natural source of phosphate for fertilizer
5. Recovery of bromine from sea water

D. Synthesis and Manufacture

1. Synthesis of electrically conducting solids (not pure metals or alloys)
2. Synthesis of DMSO
3. Synthesis of TNT
4. Reducing agents used in organic synthesis
5. Manufacture of nitric acid
6. Preparation of antibiotics by fermentation
7. Manufacture of paper

E. Physical Properties, Numerical Data

1. T_m, d, n_D, and solubility of camphor
2. O-O bond length in O_3
3. Half life of tritium and its mode of decay
4. Optical rotations for a variety of sugars at different concentrations
5. Phase diagram for an Fe-C steel
6. Physical properties of nitroglycerin
7. Physical properties of UO_2
8. Hardness, specific gravity, colors, streak, crystal structure of hematite
9. Physical properties of alkali metals in liquid ammonia

F. Chemical and Physiological Properties, Numerical Data

1. Activation parameters and kinetics of selected reactions
2. K for picric acid
3. E^0 for the U^{4+}/UO_2^{2+} couple, in acid solution
4. Chemical properties of Pu

5. Decomposition of hydrazine
6. Grignard reactions
7. Reactions catalyzed by Raney nickel
8. Physiological effect of HCN

G. Uses of

1. Nitroglycerin
2. N_2H_2
3. $NaSO_4 \cdot 10H_2O$
4. BF_3 as an organic reagent
5. Lasers in chemistry

H. Identification, Testing, Analysis, Measurement, Lab Techniques

1. Identification of a solid carboxylic acid with T_m 100°C
2. General test methods for textiles
3. Standard analysis for carbon
4. Analysis of DDT in milk
5. Determination of gases in metals
6. Radiochemical methods of analysis
7. Colorimeteric method for ClO_4^-
8. Photoelectric measurements
9. Vapor pressure measurements
10. Kinetics of fast reactions
11. Glassblowing techniques
12. How to clean glassware

I. Theory

1. Hydrogen bonding
2. Nature of the colloidal state
3. Multicentered bonding
4. Viscosity of liquids
5. Thermodynamics in the presence of electric, magnetic, and gravitational fields
6. Kinetic theory of the thermal conductivity of gases

J. Biography and History

1. The birthdate and education of Marie Curie
2. A short biography of Henry Cavendish with references to more detailed biographies
3. A description of Rutherford's Au foil experiment
4. Lavosier and the chemical revolution
5. Nobel lectures in chemistry
6. The discovery of phosphorous
7. The origins of physical chemistry
8. The first publication on the concentration dependence of cell voltages

K. Miscellaneous

1. Address for McGraw-Hill
2. List of current physical chemistry texts
3. Supplier for goniometers
4. Research of geochemists at Colorado School of Mines
5. A bibliography of spectral compilations

ANSWER SHEET FOR EXERCISE 1

Category	Subject No.	Reference
A		
B		
C		
D		
E		
F		
G		
H		
I		
J		
K		

IV. EXERCISE 2.

SEARCHING FOR GENERAL INFORMATION ON A CHEMICAL TOPIC

This is a guided exercise to introduce you to a method of library research. Upon completion, you should have acquired a knowledge of the basic chemical reference tools in a chemical library as well as an understanding of a search technique central to library research.

In attempting a library search it is important to know when to use the various sources. The search we will attempt can be thought of as a linear activity in which you will progress from one state of knowledge to a more advanced state. This is accomplished by starting from a general point in the tertiary literature, updating and refining the topic by using additional tertiary and secondary sources, and then obtaining specific knowledge of the current research by locating primary materials.

The starting point of the search may be at any level of difficulty. If a research question uses vocabulary unfamiliar to you, the first step is the use of a specialized dictionary such as A New Dictionary of Chemistry[2] (edited by L. M. Miall and D. W. A. Sharp). Is the term "electrode potential" in this dictionary? _____

Once the terminology of a topic is satisfactorily understood, the best place to go is either a text or an encyclopedia. These types of sources should always be accessed through their indexes for the most complete results.

One of the best scientific encyclopedias available is the McGraw-Hill Encyclopedia of Science and Technology.[3] Using the index, locate the subject of "physical chemistry." The numbers following the term refer to the volume and page numbers of the section on that subject. Main articles are indicated by an asterisk (*). Look it up. What is the title of the encyclopedia's general article on physical chemistry? _____

Glance through the article. Are there any references to other articles in the encyclopedia (see references)? _____

If so, give two examples. _____

Many articles and textbooks sprinkle these "see references" throughout the text to guide the reader toward more specific information. It is also common to group these types of references at the end of the entire article to stimulate further study.

Now look at the end of the article and locate the bibliography. This is a select listing of sources deemed worthy by the author of the article. Do we own any of the books mentioned? If so, reference two of them.

_____

Let's say you want to find detailed information on electrode potentials.* Use the index again under the term of physical chemistry. Note the subjects listed beneath it that are related or are narrower topics. Which one(s) might help in your search? _____

What happens when you look up "Chemistry, physical" in the index?

_____

Since encyclopedias are not revised as often as discoveries are made, they are updated by yearbooks. Check the 1977 through 1981 McGraw-Hill Yearbooks of Science and Technology[4] to see if they contain anything relating to the subject of physical chemistry. (Be sure to use the yearbook index.) What do you find? _____

Textbooks also have valuable bibliographies (lists of books or articles) that follow each chapter or are compiled at the end of the work. Never overlook these as a source of valuable information because these are titles

_____

*Information on electrode potentials, not other aspects of electrodes, is sought.

that have been recommended by an expert in the field. Find such a bibliography in a physical chemistry text on the topic of "electrochemistry" and reference the text. _____

Locate a monograph or treatise mentioned in this bibliography on electrochemistry; use it to find a bibliography relating to electrode potentials and reference the monograph or treatise. Be sure when referencing any work to include the author (or editor), title, edition, publisher, place of publication, year of publication, and page numbers of interest.

THE CARD CATALOG

In finding out whether or not we owned any of the books listed in the bibliography of the encyclopedia article, it was necessary to use the card catalog. Our card catalog is divided; that is, we have one section where authors and titles are interfiled and a separate section of subject cards for books we own. You used the author-title catalog and found at least one of the books listed, but you might not have known that much of the information on the card you found could be of use to you.

QD
553
P6613

Pourbaix, Marcel Jean Nestor.
Atlas of electrochemical equilibria in aqueous solutions/by Marcel Pourbaix; translated from the French by James A. Franklin (except sections I, III 5, and III 6, which were originally written in English).--2d English ed.--Houston, Tex.: National Association of Corrosion Engineers, 1974.
644 p. : diagrs. ; 27 cm.
Includes bibliographical references and indexes.

1. Electrochemistry. 2. Phase diagrams.
I. Title.

Most of this information you already understood. A different call number is assigned by the Library of Congress to each book. LC call

numbers are actually composed of both letters and numbers in combinations that separate basic subject areas.

Tracings are a list of all headings under which that particular book is listed. The headings listed after Arabic numberals can be found in the subject catalog while those listed after Roman numerals are found in the author-title catalog. The tracings portion of the card can be very helpful in locating other books on the same topic.

What are the subject headings assigned to the book by Pourbaix?

_____

Subject headings are assigned to each book as it arrives in the Library, but there are many problems with this system. If we receive a general text on physical chemistry, should it be entered under "Physical Chemistry," "Chemistry, Physical and Theoretical," or "Chemical Physics"? Look these terms up in the subject catalog. Which one(s) have books listed under them? _____

Since it is so difficult to assign headings arbitrarily, the Library of Congress has issued a book listing all headings and indicating which ones are preferred. The LC Subject Headings[5] list is then used by other libraries to assign headings. To save time, the student may consult this list to identify terms to be used in a search of the subject.

The following are some examples from the LC list. Study the examples carefully to make sure you understand designations such as: sa, x, xx, subheadings (--), and see references.

Chemistry, Organic (QD248-449)

sa Carbon compounds
Stereochemistry
x Organic chemistry
--Laboratory manuals (QD 261)
--Synthesis (QD262)

Chemistry, Physical and theoretical (QD453-651)

sa Atmospheric chemistry
Chemical reaction, Rate of
x Physical chemistry
Stoichiometry
xx Stereochemistry

Chemistry, Surface
See Surface Chemistry

Please complete the following to test your understanding of the examples.

Chemistry, Nuclear See Nuclear chemistry	1. _____
Chemistry, Physical organic	2. _____
sa Conservation of orbital symmetry	3. _____
x Physical organic chemistry	4. _____
xx Chemistry, organic	5. _____
--Methodology	6. _____

A. A synonym which should not be used as a subject heading

B. A related heading which can be used if looking for more specific material

C. Main subject heading

D. Subheading which can be used with Chemistry, Physical organic

E. A broader heading than Chemistry, Physical organic. You may wish to consult this heading if the card catalog contains nothing under Chemistry, Physical organic.

F. See reference from a possible heading (but which is unacceptable) to the heading which should be used instead

There are two other aspects of the LC list that should be mentioned. Many headings are followed by an LC call number such as "Chemistry, Physical and theoretical (QD453-651)." This number or range of numbers represents the location of books on the most common aspect of the subject

heading. If your subject heading happens to have a classification number after it you may choose to avoid the catalog entirely and go directly to the shelves and browse.

The second aspect is the use of "form headings." These are subdivisions that may be used to divide a subject heading even if they are not listed under it in the LC list. The following may be used to subdivide any heading:

--Abstracts
--Addresses, essays, lectures
--Bibliography
--Case studies
--Congresses
--Dictionaries
--Handbooks, manuals, etc.
--Periodicals
--Statistics
--Yearbooks

Using the LC list, list some valid subject headings for the topic of "electrode potential." _____

Find these headings in the subject catalog and list several books (if possible) that might be useful to a study of the topic. _____

_____

You are now able to compile a list of secondary and tertiary sources related to the topic. Normally you would proceed to look at the books found, checking for bibliographies in them and pursuing each relevant title to uncover more secondary and even primary materials if needed.

This is not necessary for our purposes. When all the materials have been gathered together, you would proceed to sort through and evaluate them. When this process is complete you would have a basic understanding of your topic and could then work to fill in gaps and update material through the use of review serials. Ideally you would then follow up on some specialized aspect of the subject by locating recent research through the use of indexing and abstracting services.

However, not all searches proceed in this ideal manner. In an actual search some of the steps may lead nowhere. For example, if you were dealing with a very new aspect of research there may not be any books covering that topic at the present time. Do not get discouraged. Every library research project is different and you are bound to come away empty at certain points. The library user is encouraged to be patient and methodical when performing a search. When the system proves unusable, consult a librarian.

REVIEW SERIALS

Since textbooks and monographs take two to three years to be published, the books in the card catalog and the references in their bibliographies are usually several years old and do not take recent research into account. Therefore, it is necessary to find a way into the current research to update your topic. One of the ways to do this is via review serials. Another approach is to use indexes, e.g., Chemical Abstracts. Chemical Abstracts is of such importance to chemists that a separate exercise (Exercise 3) has been designed to illustrate its use.

A review serial contains articles that review the current research on a specific topic. These publications can be published monthly, quarterly,

semi-annually, annually, or biannually. To compile the review article an author looks at selected research for a given time period and lists the research articles in a bibliography that can have as many as 600 citations. The author then briefly summarizes the research--its direction, issues, problems still to be explored--and thus critiques where the field is at that point.

Review serials in general are difficult to locate in the library as some are classed as books (such as an Annual Review) and some are treated as periodicals (and are therefore not listed in the card catalog). You are probably aware of some review serials although you may not have realized they did not contain reports of original research. Physical chemistry review series, as well as review journals, are listed on page 7 of Shoemaker and Garland.[6] How many of the review journals does out library take? _____

How many review series? _____

Of those review serials that our library owns, have any reviewed electrode potentials in the last year? If so, reference the article(s) or chapter(s). (Use December 1981 indexes in the review journals if available.) _____

INDEXES

CHEMICAL ABSTRACTS[7]

1977 Index Guide

When using either the Chemical Substance Index or the General Subject Index, it is a good idea to consult the Index Guide to be sure that you are using the proper subject heading. Subject headings are based on the content of the actual document, not just on the information provided by the abstract.

Chemical Substance Index (Semi-annual index)

Entries for completed defined substances (such as all chemical elements and chemical compounds, alloys of specific metals, specific antibiotics, and trade-name designations).

Benzoic acid [65-85-0], biological studies
catalase inhibition by, in soils, 129546y
Benzoic acid, esters
in food packaging, R 30956v
butyl ester [136-60-7], plasticizers, for vinyl chloride polymers, P 80259r
methyl ester [93-58-3]
hydrolysis of, B 54551k, 133359g

General Subject Index (Semi-annual index)

Includes all of those index headings which do not refer to specific chemical substances.

Chromatography
R 63904r
Stomach, metabolism
acid secretion by, in diabetes, 40448m

Formula Index (Semi-annual index)

The best way to quickly find references for a single chemical compound provided that you know the complete molecular formula.

$C_{20}H_{32}N_4O_4S_8Se$
4-Morpholinecarbodithioic acid tetrakis (anhydrosulfide) with orthothioselenious acid [76081-18-0], 24239b

Keyword Index (Weekly index)

Entries are derived from the title, text, or contents of the abstract.

Patent Index (Weekly index, cumulated semi-annually)

Entries by country/patent number.

Author Index (Weekly index, cumulated semi-annually)

Personal authors and corporate entries.

Gschneidner K A Jr 142831g
GTE Products Corp. P 140878d

Sample Abstract

95: 138730f Theory of electronic transitions in slow atomic collisions. Delos, John B. (Phys. Dep., Coll. William and Mary, Williamsburg, VA 23185 USA). Rev. Mod. Phys. 1981, 53(2), 287-357 (Eng). A review with many refs. with discussion of quantum and classical theories of atom-atom and atom-ion collisions.

Entry in Keyword Index

Atom
collision theory review 138730f

Electronic
transition atom ion collision 138730f

Entry in Author Index

Delos J B 138730f

Chemical Abstracts Service Source Index

Provides full titles from abbreviated source entries found in abstracts. Also includes the publication history, the publisher's name and address, as well as holding libraries.

Other Indexes - Please remember that these are not wholly unique indexing services. Documents may be found in one or more of these sources.

Biological Abstracts[8]

BA covers over 8,000 journals worldwide and provides access to the literature of the life sciences. Like Chemical Abstracts, it includes an abstract or summary or the document in addition to bibliographic information (such as the author, title, source, etc.).

Each issue of BA contains a set of abstracts and five indexes: the author index, biosystematic index, generic index, cumulative concept index, and subject index. Every six months a cumulative set of the five indexes is published so that use of the indexes in each individual issue becomes unnecessary.

Science Citation Index[9]

SCI covers all the sciences including the physical, biological, and chemical sciences. Its purpose is a little

different than BA or CA in that it uses the bibliography included in a document as well as other bibliographic information.

There are four indexes: the author index, author affiliation index, keyword index, and citation index. The keyword index is the only direct subject approach and is seriously deficient compared to the indexes available with BA or CA. This fault is more than compensated for by the unique citation index. The citation index provides access to documents through the list of references (citations) usually provided in each document. This index is particularly useful when information needs to be updated--simply check the citation index for authors who have cited the original document.

Current Contents[10]

CC is unlike any other index in that it serves as a current awareness tool. While there are perfunctory author and keyword indexes, the main purpose of CC is to provide a page by page listing of the table of contents of each journal covered. Also, it is not unusual for CC to be published long before many of the journal titles included in that issue of CC are published and distributed.

COMPUTER SEARCH SERVICE

A computer search service is available through the Reference Department of the UCCS Library for a fee to cover vendor charges. These charges vary depending on the vendor and on the nature of each individual search and usually ranges between five and thirty dollars.

The UCCS Library currently uses two vendors: DIALOG Information Retrieval Service and Bibliographic Retrieval Services. DIALOG supplies over 130 data bases, all with online access. BRS supplies as many data bases, not all able to be accessed online but are offered at a less expensive rate.

Data bases available include: CA SEARCH, CHEMNAME, CHEMSEARCH, NTIS, SCISEARCH, BIOSIS PREVIEWS, SPIN, COMPENDEX, ENERGYLINE, and ENVIROLINE.

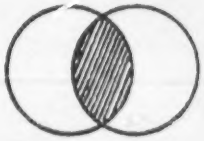
CA SEARCH is the data base which corresponds to the printed Chemical Abstracts. Information is available back to 1967 and the data base now contains more than 5,000,000 records and is updated biweekly.

The following list indicates possible ways of accessing a single record in the CA SEARCH data base:

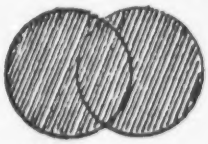
CA Abstract number
Document title
Author(s) name
Author affiliation
Source of document
Year of publication
Publication type (journal, patent, technical report, book, conference paper, dissertation)
Language of document
Approrpiate subject headings (from Index Guide)
Molecular formula
CAS Registry number
Patent assignee (if applicable)
Patent number (if applicable)
Keywords

Boolean Logic

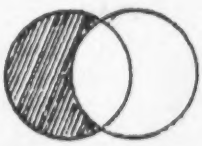
AND pesticides and residues



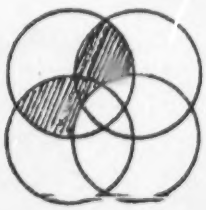
OR residues or pollution



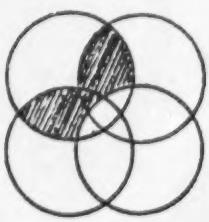
NOT pesticides not food



(pesticides and [residues or pollution]) not food



pesticides and ([residues or pollution] not food)



V. EXERCISE 3.

USING CHEMICAL ABSTRACTS

1. The following three citations have appeared within the last seven years of Chemical Abstracts:

   John D. Hostettler; "A decade of chemistry for nonscientists - 1968 to 1977"

   James M. Steichen; "The effect of lake destratification on water quality"

   Jan M. Van Nueten; "Unexpected reversal effects of naloxone on the guinea pig ileum"

   For each citation:

   a. Indicate the volume number in which the article was abstracted as well as the year and the abstract number

   b. Indicate the source of the article, the year of publication, page numbers, and other bibliographic detail

   c. Indicate the author's affiliation (the location where work was submitted from)

2. The following six questions have been dealt within the last seven years of Chemical Abstracts:

   What immunological method of detecting proteinase in beer is most sensitive?

   What effect does benomyl have on the docosanol of lettuce leaf wax?

   What should you use with calcined oyster shells to pickle vegetables?

   A review article mentions the role of two body organs on the physiology of thirst, what are they?

   What is a simple and quick method to qualitatively assess used frying fats?

   Does cyclosporin A inhibit dental caries in rats?

Please answer three of these questions and give the complete original reference as well as the abstract number and volume of Chemical Abstracts used to answer each question.

3. Using the 1907-1979 cumulative edition of Chemical Abstracts Service Source Index, indicate for three of the following abbreviations the complete title, the publisher, and two holding libraries:

   Bull. At. Sci.

   C. R. Hebd. Seances Acad. Sci. Ser. B.

   Aqueous-Environ. Chem. Met. 1974.

   J. Labelled Compd. Radiopharm.

   Phys. Fluids.

   Proc. Int. Congr. Pure Appl. Chem.

   Recent Dev. Sep. Sci.

   Theory Appl. Gas Chromat-gr. Ind. Med. Proc. Hahnemann Symp. 1st. 1966. 1968.

4. Prepare an abstract of a 1981 primary journal article (at least two pages) of your choice. Follow rules about abbreviations. For additional information see pages ix - vxii in the 1982 Abstracts; 96(1). Please include the name of the one (of 80) abstract sections in which your abstract would appear.

REFERENCES CITED

1. Annual Review of Physical Chemistry. Palo Alto, CA: Annual Reviews Inc., 1950- .

2. Miall, Laurence M. and D. W. A. Sharp (eds.). A New Dictionary of Chemistry. 4th ed. New York: Wiley, 1968.

3. McGraw-Hill Encyclopedia of Science and Technology: an international reference work in fifteen volumes including an index. 4th ed. New York: McGraw-Hill, 1977.

4. McGraw-Hill Yearbook of Science and Technology. New York: McGraw-Hill, 1962- .

5. United States. Library of Congress. Subject Catalog Division. Library of Congress Subject Headings. 9th ed. Washington: Library of Congress, 1980.

6. Shoemaker, David P., C. W. Garland, and J. I. Steinfeld. Experiments in Physical Chemistry. 4th ed. New York: McGraw-Hill, 1981.

7. Chemical Abstracts. Columbus, OH: American Chemical Society. Chemical Abstracts Service, 1963- .

8. Biological Abstracts; references, abstracts, and indexes to the world's life sciences research literature. Philadelphia, PA: BioSciences Information Service, 1927- .

9. Science Citation Index. Philadelphia, PA: Institute for Scientific Information, 1961- .

10. Current Contents/Physical, Chemical and Earth Sciences. Philadelphia, PA: Institute for Scientific Information, 1961- .

ACKNOWLEDGMENT

We wish to thank Professor Elizabeth Frick, Head of UCCS Library Services, for arranging a very stimulating and excellent workshop on library resources and their use. This workshop (supported by the Council on Library Resources) provided the inspiration and motivation which made the CLEAR project possible.